Acoustic Communications ATD

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LONG-TERM GOALS

The goal of the Acoustic Communications Advanced Technology Demonstration program (ACOMMS ATD) is to provide long range and high data rate communications to meet the highest priority command in COMSUBLANT/COMSUBPAC Command Capability Issues (FY97 and FY98) of Battlespace Connectivity.

OBJECTIVES

The primary objective of the Acoustic Communications Advanced Technology Demonstration (ACOMMS ATD) is to develop and demonstrate emerging undersea communication technologies at operationally useful ranges and data rates. The secondary objective of the ACOMMS ATD is to develop a fleet-compatible advanced acoustic communication capability that can easily be transitioned into planned Fleet sonar system commercial hardware upgrade programs.

Specifically, the ACOMMS ATD shall demonstrate the potential to provide a reliable, robust, high data rate acoustic communications capability for tactical use between submarines, surface combatants, unmanned undersea vehicles (UUVs), and other platforms. This communications capability includes the transmission of text data, images, and digitized voice from one operational unit to the other on a real-time (not including propagation time) basis over both short range (2.5 nm - environmentally dependent) at high frequency, and long range (35 nm - environmentally dependent) at medium frequency.

APPROACH

The ACOMMS ATD shall demonstrate an underwater acoustic communication capability that is free from the distortion associated with multipath interference, thus allowing for high rate digital telemetry.

The effort taken for this ATD consists of a two phased approach, initially using a PC-Based Modem System with subsequent transition to a VME-Based Modem System. Each modem system configuration includes its associated hardware, software, algorithms and related documentation. The existing PC-Based Modem System, which was previously developed by the Government through the Defense Advanced Research Projects Agency (DARPA)/ Woods Hole Institute (WHOI) research, and which will be provided as Government Furnished Property (GFP), shall serve as the technical starting base for the development of the VME-Based Modem hardware, as well as an interim development tool for upgrading of the baseline acoustic communication algorithm. The VME based modem system will

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represent the final prototype of the ATD, allowing both adequate design growth and subsequent rapid insertion of acoustic communications capability into Naval sonar systems.

A series of formal at-sea demonstrations shall be conducted during the course of this development to show how both PC-based and VME-based modem systems are achieving their specific objectives through the incremental and iterative process. These demonstrations, which will be augmented by a series of supporting tests, shall determine how well the system design performs under a variety of operational and environmental conditions, and shall verify that the exit criteria have been successfully met. The demonstrations shall be designed to show potential inter-connectivity among submerged, surfaced, and other platforms.

WORK COMPLETED

In FY98, we conducted a demonstration of high frequency communication between the USS ASHEVILLE and a research vessel at Hawaii Operating Area. We conducted a dockside test on the USS Mitscher to verify the MF transmit and receive methodologies with the SQS-53C sonar system. We conducted a test between a research vessel and an UUV (RV-UUV) in AUTEC Range. We conducted a workup test between the USS Alexandria and a research vessel in preparation for the demonstration in December 1998. We participated in experiment LWAD 89-4 to collect data for development of the interface to the SQS-53C sonar system.

We built 3 acoustic modems and interfaces on VME boards. We built and tested the transmit and receive interfaces to the BSY-1 spherical array. That system is ready for installation on the USS Alexandria for a demonstration of medium frequency communications scheduled in December 1998.

We completed the final draft of the Concept of Operation document with extensive Fleet participation.

RESULTS

During the HF demonstration between the USS ASHEVILLE and a research vessel, we were able to transmit text messages to the SSN periodically. Information such as support vessel status, position, and surface contacts (real and simulated) was received by the SSN every ten minutes to assist the SSN in its navigation. We are able to decode off-line data out to 2.5 nmi consistently (100%) for deep water.

During the test between the RV-UUV in AUTEC Range, we successfully uplinked to RV information such as vehicle status, sensor data (CTD), highly compressed still images from onboard camera via HF and MF link. We successfully (90%) decoded packets from the UUV out to 1nmi and successfully controlled the UUV via HF and MF at 1.5 nmi.

During the workup test between the USS ALEXANDRIA and the research vessel, we collected about 8 hours of SSN MF receive data. Data was collected during the transition of SSN between shallow and deepwater with significant waveguide (wedge) present throughout. We transferred texts and images at close range. Maximum range was out to 30nmi but in-situ equalization was sporadic due to dynamic and multipath. Element data are being processed in lab.

IMPACT/APPLICATIONS

Joint Vision 2010 (*JV2010*) establishes "full spectrum dominance" as the key characteristic we seek for our armed forces in the 21st century. Full spectrum dominance and its four supporting operational concepts ("dominant maneuver," "precision engagement," "full dimension protection," and "focused logistics") are utterly dependent upon Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) systems that "capture, synthesize and distribute near-real time information to all levels of operations[1]."

By making rapid ("near-real time") communications with and control of all forces the key element of national strategy, national authorities increase the importance and urgency of long standing Navy efforts to fully integrate undersea forces into Navy C4ISR systems. Moreover, the new C4ISR-oriented strategy has emerged at a time when major improvements in ACOMMS systems capabilities have become practical. Advanced ACOMMS systems would provide a unique capability; no other system can communicate in near real time and at tactically useful data rates with undersea forces at speed and depth.

Other Joint and Navy requirements documents (e.g., *Joint Warfighting Science and Technology Plan*, the Navy's *Science and Technology Requirements Guidance*, the Coordinated Fleet CINC Consolidated Command Technology Issues, the *Submarine Mission Capabilities Master Plan* and derivative Master Plans, the COMSUBLANT/COMSUBPAC Command Technology Issues, etc.) describe specific mission driven capabilities objectives that would be partially or completely met by deployment of more capable ACOMMS systems.

TRANSITIONS

The acoustic communication technology developed by the ACOMMS ATD will transition to theAN/SQQ-89 (MF) and the Acoustic Rapid COTS Insertion (ARCI) Program (PE 0604503N) of the AN/BQQ-5 and AN/BSY-1 (MF and HF) for purposes of subsequent production. Transition into ARCI will be accomplished as part of the Advanced Processing Build (APB) program starting at APB-00 in FY00. Any further incremental development efforts will transition to Submarine Combat System Advanced Development (PE 0603504N). Transition to NSSN will occur at Hull 3 and PSA into Hull 1 & 2 during the technology refresh points.

In addition, several other potential transitions exist for this technology, including Undersea Ranges (PE 0204571N), SURTASS Ship (PE 0204313N), ADNS (PE 0604784N), Fleet Communications (PE 0204163N), AN/WQC-2 and AN/WQC-6 replacement upgrade, and various potential uses within UUV development programs.

RELATED PROJECTS

[1] William J. Perry in Preface to Department of Defense, Director, Defense Research and Engineering. (1996). *Defense Science and Technology Strategy*.

REFERENCES

Acoustic Communications ATD Program Execution Plan, ASTO
Acoustic Communications Concept of Operation Document, ASTO